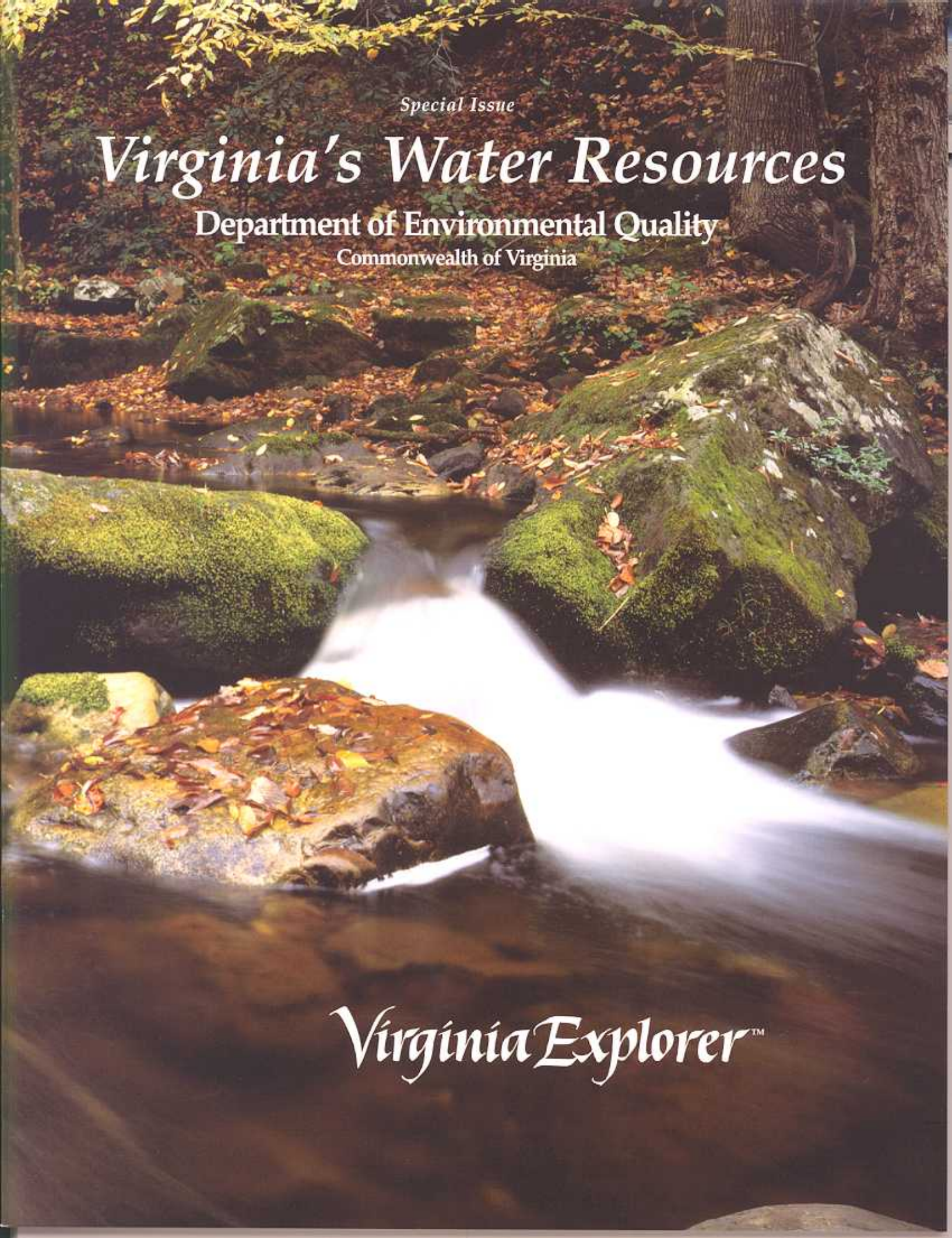


Special Issue

Virginia's Water Resources

Department of Environmental Quality

Commonwealth of Virginia

Virginia Explorer™

Did you know that...

1. Virginia covers 43,326 square miles of land and has over 1,000 square miles of inland water and 1,728 square miles of coastal waters.

2. Three percent of the water on Earth is fresh water and only 1% is available for human consumption. 2% is frozen in glaciers, and the remaining 97% is salt water.

3. Without water, the earth would look like the moon.

4. The color of water is not clear, but actually blue. Pure water absorbs red, yellow and green lights first and absorbs blue last. Since only the deepest blue light can travel very far through water, water takes on this blue color. You can see the color best in a swimming pool lined with white concrete, or in a tropical ocean far from land.

5. You could survive about a month without food, but only 5 to 7 days without water.

6. One gallon of water weighs 8.34 pounds.

7. 40 trillion gallons of water a day are carried in the atmosphere across the United States.

8. Water makes up 83% of our blood, 70% of our brain, and 90% of our lungs. Overall, our bodies are 70% water.

9. A tomato is about 95% water. An apple, a pineapple, and an ear of corn are each 80% water.

10. The United States consumes water at twice the rate of other industrialized nations.

11. It takes about 39,000 gallons of water to produce the average domestic auto, including tires.

12. It takes about 800,000 gallons of water to grow an acre of cotton.

13. An acre of corn contributes more to humidity than a lake of the same size.

14. Water expands by nearly one tenth of its volume when it freezes. 1 cubic foot of water becomes 1.09 cubic feet of ice.

15. In the United States, water utilities treat nearly 34 billion gallons of water every day.

16. A leaking faucet can waste up to 100 gallons of water a day.

17. The average American flushes about 26 gallons a day down the toilet.

18. A 10-minute shower uses about 55 gallons of water.

19. Two-thirds of the water used in an average home is used in the bathroom.

20. There is the same amount of water on Earth today as there was 3 billion years ago, and the Earth will never get any more water. Because it moves in a never-ending cycle, nature recycles used water over and over. So, the water you drink may have been a drink for a dinosaur!

Water is an important natural resource—and one that we must all work to preserve.

DEQ
VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY

Water

Virginia's Water Resources

Front Cover: *Water flows down Big Tumbling Creek in Clinch Mountain. Photo by Dwight Dyke.*

Inside Back Cover: *James River at Pony Pasture.* **Inset:** *Another view of Big Tumbling Creek. Photos by Dwight Dyke.*

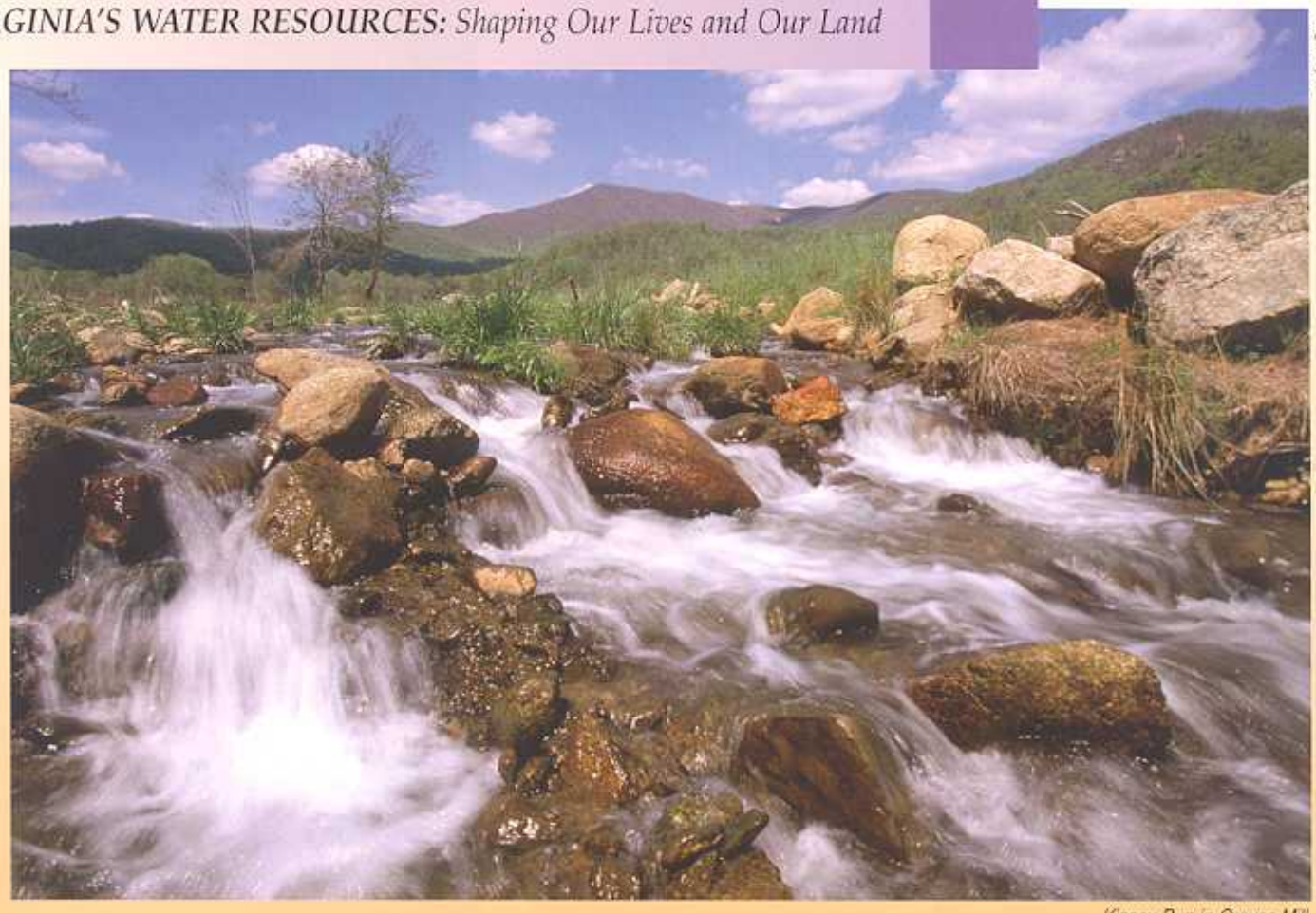
To Right: *Dragonfly photo by Jean Fogle.*

This special edition of the Virginia Explorer was made possible through the collaborative efforts of:

DEQ
Virginia Department of Environmental Quality

Virginia Museum of Natural History

VIRGINIA'S WATER RESOURCES: Shaping Our Lives and Our Land



Dwight Dyke

Kinsey Run in Graves Mill.

Virginia's water resources stretch from tiny streams as far west as Cumberland Gap to the Chesapeake Bay wetlands and the Atlantic coastline. Water comes from sources as varied as streams, rivers, lakes, reservoirs, aquifers, wetlands, the Chesapeake Bay, and the Atlantic Ocean.

Virginians have depended on water since the first inhabitants walked on the shores of the James River. They survived on water drawn from wells and built their homes on the fertile soils of the banks of the rivers. As settlers moved inland, they built dams at the Fall Line to harness the power of the rushing water for their mills.

By the 1790s, farmers who worked the lands upstream plied the waters on bateaux to carry their crops to downstream mills. Water was the most important source of power until the beginning of the Industrial Revolution. Industries depended on the power of the free-flowing water to drive water wheels and machinery.

Today we depend on lakes, reservoirs, and ground water for our drinking water supply as well as for manufacturing processes. The Chesapeake Bay provides us with seafood, recreation, and a beauty known around the world. In a state that is steeped in history and bountiful natural resources, Virginia's waters continue to shape our lives and our land.

How Virginia's Water Measures Up

State Surface Area..... 40,741 square miles
Perennial River Miles (Non-Tidal)..... 49,350

Miles of Border River (Potomac)..... 180

Publicly-Owned Lakes and Reservoirs	Number	Acres
Greater than 5,000 acres	5	109,838
Less than 5,000 acres	243	52,392
Total	248	162,230

Acres of Freshwater Wetlands 808,000
Acres of Tidal and Coastal Wetlands 236,900
Estuary Square Miles..... 2,500
Atlantic Ocean Coastal Miles 120

Total Coastal Shoreline Miles, including Chesapeake Bay and Tidal Tributaries to a Width of 110 Feet—3,315

Statewide Average Annual Rainfall—42.8 inches

Average Freshwater Discharge of All Rivers—Approximately 25 billion gallons per day

River Basins in Virginia

Potomac-Shenandoah

About one-third of the Potomac basin lies in Virginia, yet none of the river flows through the Commonwealth. The biggest challenges in the Potomac subbasin come from urban and suburban runoff. In the Shenandoah subbasin, the main source is agricultural runoff. There is mercury pollution in the South Fork of the Shenandoah and PCBs near Front Royal.

Rappahannock

The Rappahannock is about 200 miles long and up to seven miles wide at several points. Sediment and nonpoint source pollution are the top priorities in this basin, with excess nutrients becoming a growing concern.

York

The Mattaponi and Pamunkey rivers join at West Point to form the 34-mile-long tidal York River which culminates at Yorktown. The challenge in this basin is the disappearance of submerged aquatic vegetation (seagrass) beds in the lower York estuary.

James

The James River Basin is Virginia's largest river basin. The 340-mile James is one of the longest rivers in the United States lying within the boundaries of one state. The biggest challenge for the James is at Lynchburg and Richmond where raw sewage can mix with storm water during heavy rainstorms.

Roanoke

There are four man-made reservoirs in the Roanoke river watershed: Smith Mountain Lake, Leesville Lake, Buggs Island Lake, and Lake Gaston. In the Roanoke basin, managers are working on long-term protection from nonpoint source pollution runoff, especially dairy farm and urban runoff. A fish advisory for PCB contamination is in effect on a 79-mile stretch of the river.

New

One of the oldest rivers in the world, the New River flows north for 320 miles, creating some of the most challenging whitewater stretches as it descends 1,000 feet on its way to the Mississippi. The river below Claytor Lake is receiving relatively high levels of nutrients, which some say is causing excessive growth of aquatic plants.

Tennessee-Big Sandy

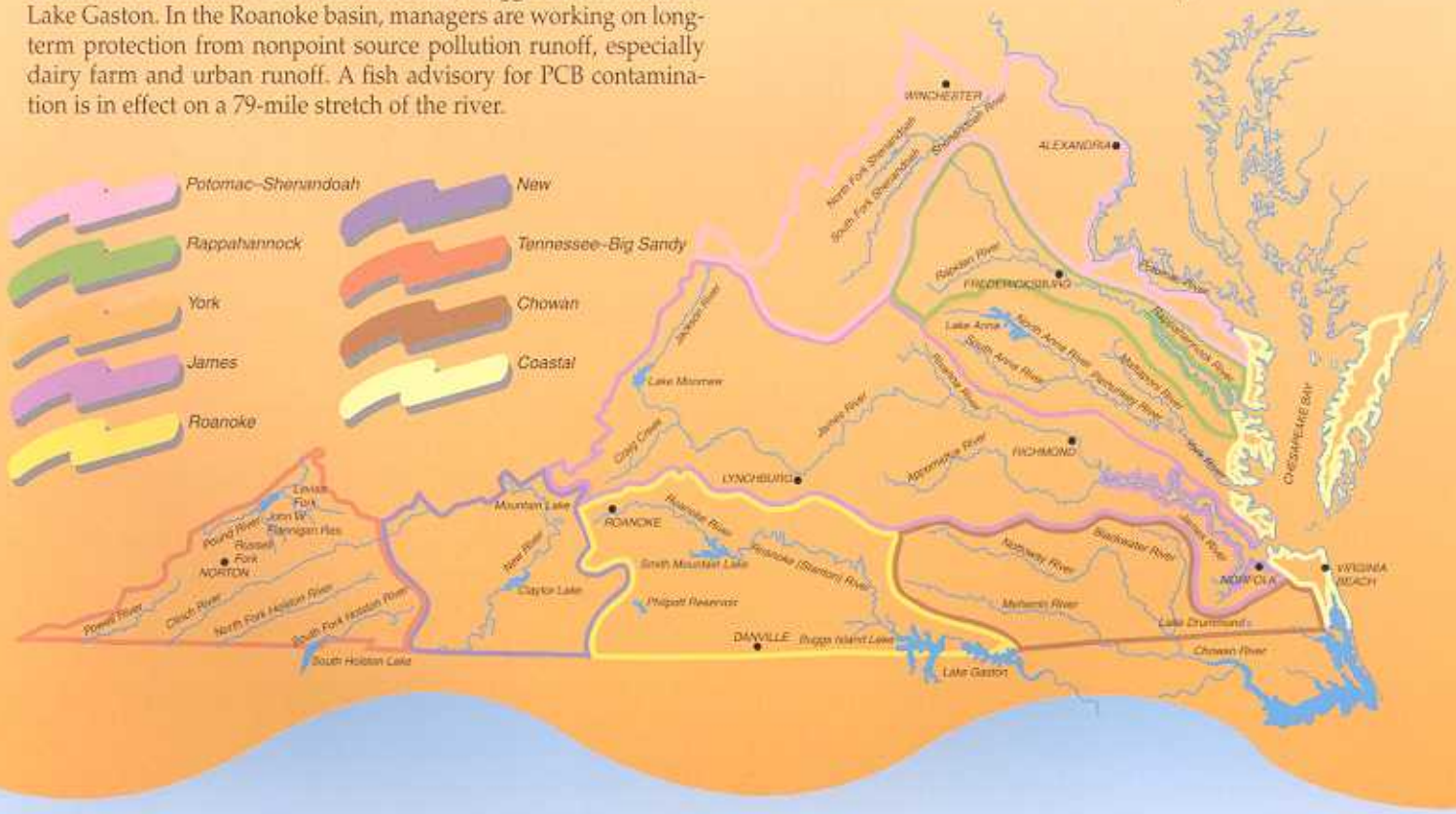
Many southwest Virginia mountain streams feed the Tennessee and Big Sandy Rivers. The Clinch/Powell and Holston rivers lead to the basin and are home to more than 100 different types of freshwater fish and mussels. Coal mining is a concern for the Clinch/Powell River. The Holston is impacted by nonpoint source agriculture and still has a prohibition on consumption of fish due to mercury pollution which occurred in the early 1970s.

Chowan

The Chowan River forms on the Virginia/North Carolina border and flows 145 miles through flat terrain and swamps on its way to the Albemarle Sound. Streams in this basin are naturally "swampy." They are acidic and often have low levels of dissolved oxygen needed for aquatic life.

Coastal

This area, with its mix of saltwater and freshwater driven by tide and wind-driven currents, is called Tidewater. Marshlands and wetlands help make it among the world's richest ecosystems. Some of these waters are affected by nutrient over-enrichment. There have also been shellfish bed closures due to bacteria contamination from unknown sources and a loss of seagrass beds.



David Liebman

There are only two natural lakes in Virginia. Mountain Lake in Giles County is a beautiful 60-acre, privately owned resort with a depth of over 150 feet. Lake Drummond (at right), which forms the center of the Great Dismal Swamp, is only six feet deep.

David Liebman

Cypress trees in the Great Dismal Swamp.

Eutrophication

Man-made lakes are subject to accelerated eutrophication almost from the onset of construction. "Eutrophication" is a term used to define nutrient enrichment in lakes, reservoirs, and estuaries. Eutrophication is a natural aging process in lakes. Lakes serve as collection bowls for materials in the watershed. As they mature, they gradually become more shallow as they fill up with sediments, nutrients, and the plants that feed on fertilizer. Over long periods of time they become wetlands and ultimately, dry land. This natural aging process can be accelerated, especially in man-made lakes placed close to human activities and development. This condition is called cultural, or accelerated, eutrophication.

Rob Simpson

Aerial view of Lake Frederick.

Virginia Division of Tourism

Smith Mountain Lake near Roanoke.

"Great Shellfish Bay"

The Chesapeake Bay is the largest estuary in the United States and represents a complex and valuable ecosystem. Its watershed, or all the land from which water drains into the Bay, extends from a small stream near Cooperstown, New York, down to its mouth at Norfolk, Virginia and covers 64,000 square miles. Thirty-seven percent of the watershed lies in Virginia. The vast network of rivers and streams that forms the watershed flows through portions of six states and the District of Columbia toward the major tidal tributaries and the main stem of the Bay. There, freshwater mixes with saltwater from the ocean to form a productive estuarine environment. Although the Bay is a shallow body of water, averaging only 21 feet in depth, numerous types of habitats exist that support a diverse array of aquatic plants and animals.

Virginia's portion of the Chesapeake Bay includes the main stem from the mouth up to the Potomac River. The waters of the Bay are also considered to include the tidal portions of the Rappahannock, York, and James rivers and the small creeks and bays that drain directly into the Bay along its eastern and western shores. These waterways drain almost 24,000 square miles of Virginia, representing approximately 56 percent of the Commonwealth.

Historically, the waters of the Chesapeake Bay have been famous for their bountiful harvests of crabs, oysters, striped bass, shad, and many other commercially valuable species. However, the productivity of the Chesapeake Bay has declined in recent years due to a number of factors, including diminished water quality, over-harvesting of certain species, reductions in habitats (such as submerged aquatic grasses), and, in the case of oysters, the effects of diseases.

U.S. Fish and Wildlife Service

Inset: Chesapeake Bay watershed

Chesapeake Bay Foundation

Workboat on the Chesapeake Bay.

The Chesapeake Bay Agreement

In 1983 Virginia joined with the states of Maryland and Pennsylvania, the District of Columbia, and the EPA in signing the Chesapeake Bay Agreement. This agreement, which has been further refined and developed over the years, has led to the establishment of a comprehensive interstate program for restoring water quality and habitat in Bay waters. The current focus is on the water quality problems that exist in the rivers, streams, and creeks that form the tributaries to the Bay. Restoring the water quality of these tributaries will lead to the restoration of the water quality, habitat, and living resources of the Bay.

Dwight Dyke

This well-established, healthy wetland helps store, release, and filter water.

Wetlands: Nature's Water Purifiers

In Colonial times and even into the 20th Century, wetlands were viewed as bug-ridden, disease-bearing, inhospitable lands that should be avoided or eliminated. Today we recognize that wetlands perform a valuable role in our environment.

Wetlands serve as nature's sponge, storing water in vegetation and above and below ground during wet periods and releasing water to streams and rivers during dry periods. They help with flood control, as wetlands along rivers and streams can hold water for periods of time and slow it down as it moves downstream. By slowing water movement and wave action, wetlands minimize erosion. Wetlands are also a natural filter; they can remove excess nutrients that may enter water from surrounding agricultural land or from industrial and municipal discharges and they can trap sediment from land development within their watershed.

Wetlands are also an important wildlife habitat for migratory birds, waterfowl, and aquatic organisms. They also serve as a nursery for many fish and shellfish species.

You may know wetlands as swamps, marshes, bogs, and bottomlands. Tidal wetlands, which are found along coastlines, can be saltwater or freshwater and are subject to the daily fluctuations of the tides. Nontidal wetlands can be found connected to tidal wetlands, along rivers and streams, or in isolated lowlands. These areas all share common elements that classify them as wetlands. Each contain hydric soils, or soils that can hold water for moderate to long periods of time, and water-loving vegetation that can tolerate being inundated by water for portions of their growing season. Wetlands also have a water pattern, or hydrology, that keeps water levels at or above the surface for a large portion of the growing season.

Wetlands are unique environments with characteristics of both land and water. This makes them very productive ecosystems as they have an abundance of light, water, and nutrients; but this also makes them very sensitive to human impacts.

Between the 1700s and the 1980s, over 53 percent of our nation's wetlands were lost. Fortunately, through federal, state, and local regulatory programs and through public awareness, this rate of loss has been slowing. Permits are now required to develop wetlands and efforts have been made to preserve existing wetlands, create new wetlands, and restore and enhance damaged wetland areas.

DEQ works with other agencies to ensure that development within wetlands is conducted in an environmentally sound manner and that unavoidable wetland losses are replaced through creation of new wetlands or restoration and enhancement of existing ones. Other state agencies such as the Department of Game and Inland Fisheries and the Department of Conservation and Recreation work with landowners to voluntarily restore and preserve wetlands throughout the Commonwealth.

Virginia's Ground Water Resources

Virginia is a geographically fascinating place! There are five physiographic provinces in Virginia, displaying a wide variety of underground formations, rocks, and soil. They are, from east to west, the Coastal Plain, Piedmont, Blue Ridge, Valley and Ridge, and Cumberland Plateau. Each area has a different effect on its ground water.

Coastal Plain

Characterization: thick, unconsolidated sedimentary deposits.
Ground Water Availability: large quantities. In this province large capacity wells are generally constructed in deep confined aquifers and are capable of yielding millions of gallons of ground water per day (up to 3,000 gallons per minute [gpm]).
Ground Water Quality: areas exist where naturally occurring chloride and fluoride levels exceed potable levels.

Piedmont

Characterization: igneous and metamorphic rocks with ground water occurring primarily in secondary fractures.
Ground Water Availability: moderate quantities (10 to 200 gpm).
Ground Water Quality: generally of good quality but there are areas of naturally occurring high iron, acidity, and other dissolved minerals.

Blue Ridge

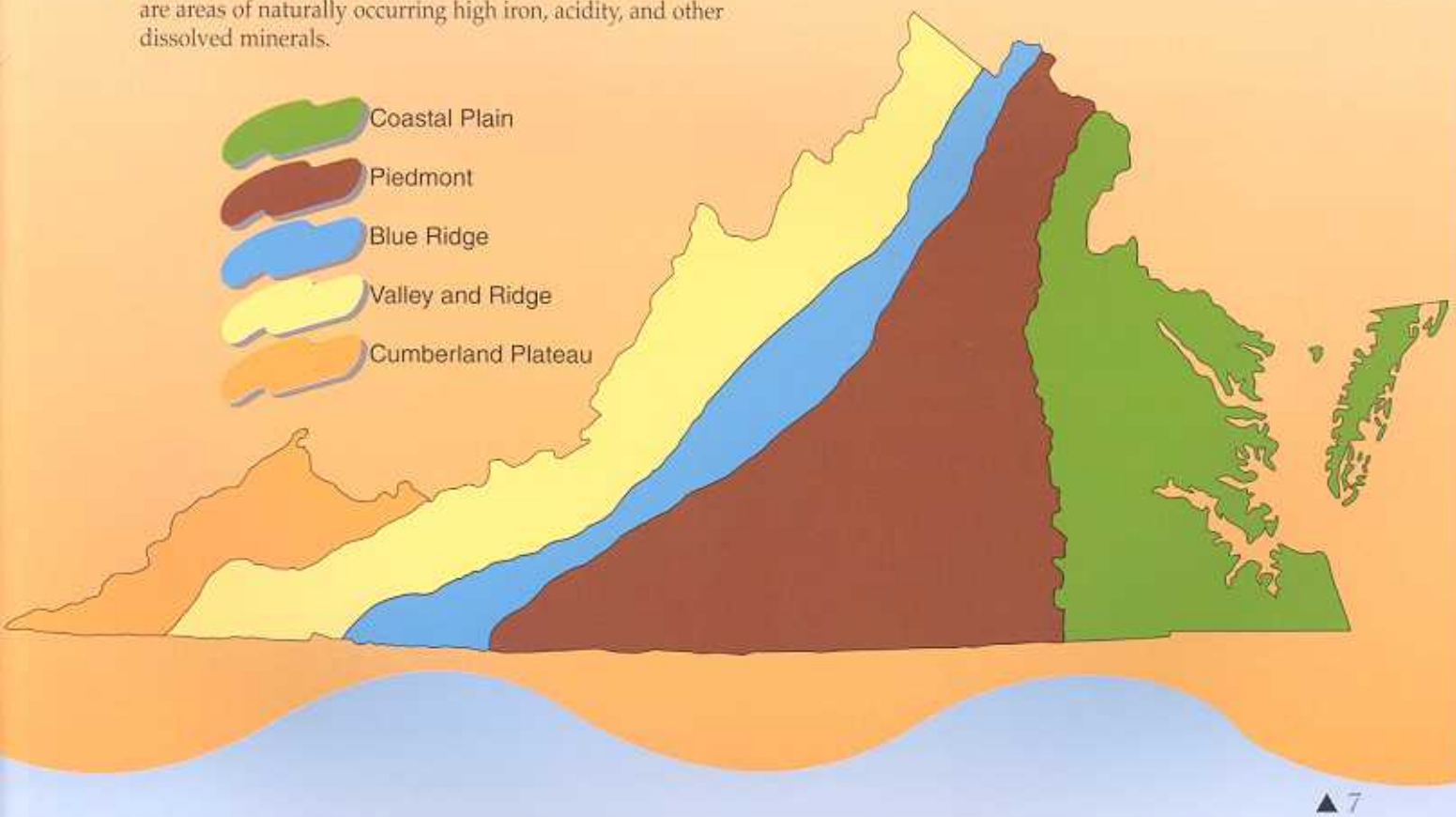
Characterization: steep slopes and very shallow soil cover.
Ground Water Availability: more limited.
Ground Water Quality: generally of good quality but there are areas of naturally occurring high iron, acidity, and other dissolved minerals.

Valley and Ridge

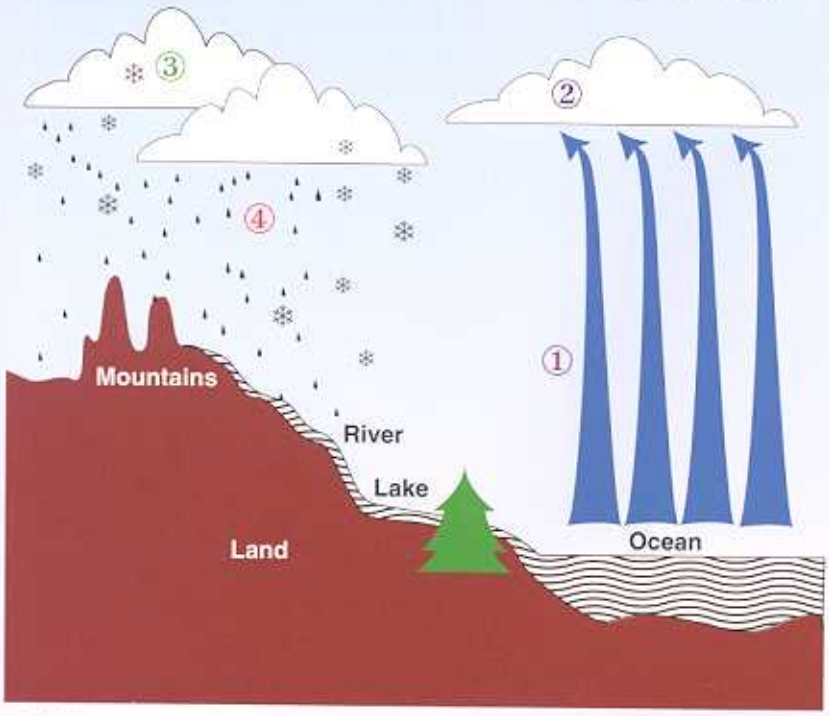
Characterization: interlayered shale, sandstone, and carbonate rocks.
Ground Water Availability: varying quantities. In carbonate areas with significant karst development, large ground water yields (up to 1,000 gpm with numerous large springs discharging more than 3,000 gpm) are available from wells that intersect solution cavities. In areas characterized by shale, deposit yields are significantly lower (50 to 200 gpm).
Ground Water Quality: characterized by naturally occurring high levels of hardness while the shale areas commonly contain high sulphate, iron, and total dissolved solids.

Cumberland Plateau

Characterization: relatively horizontal formations of sandstones, shales, and coal beds.
Ground Water Availability: small to moderate amounts (10 to 50 gpm).
Ground Water Quality: characterized by ground water with elevated iron, sulphate, manganese, acidity, and total dissolved solids.



Where does the water come from?



① Water evaporates from the ocean, lakes, and other bodies of water.
② The water condenses into clouds.
③ Clouds drop rain or snow into the watershed.
④ Water runs off and collects in a river and runs to the ocean or infiltrates to ground water, recharging underground water resources.

Above: *The world's water is constantly being recycled through the natural processes of evaporation, precipitation, and runoff. Water is naturally cleansed by the biological activity of digestion of organic waste.*

Water is one of our most important natural resources. We need clean water to keep us alive.

Ground Water: Virginia's Buried Treasure

Ground water is found within the saturated pore spaces of soil, sediments, and rocks. The quantity and quality of the water is determined by the nature of the local sediment and rock. In most places, ground water travels very slowly and stays in contact with soil and rock for a long time, picking up minerals along the way. Underground and out of sight, you might think ground water is crystal clean, but ground water can become contaminated by any number of sources including leaking septic fields, petroleum tanks, and old landfills.

Did You Know?

▼ Ground water is usually available in quantities and qualities necessary to support individual domestic users and small to moderate commercial and industrial users throughout the Commonwealth.

▼ Eighty percent of Virginians rely on ground water as the source of at least a portion of their daily water needs.

▼ Seventy-nine percent of the community public water supplies in the Commonwealth are dependent on ground water supplies. (In 38 of Virginia's 95 counties all public water supply systems are totally dependent on ground water.)

▼ Virtually all residences, commercial, industrial, and agricultural operations not served by public water supplies are reliant on ground water for the supply of domestic and process water.

▼ In 60 of Virginia's 95 counties, private domestic wells serve the daily needs of the majority of the citizens.

▼ In 10 of Virginia's 95 counties, private domestic wells serve the needs of more than 85 percent of the population. In addition, ground water is used extensively for commercial, industrial, and agricultural operations. These operations often rely solely on ground water supplies and are major contributors to the economy of broad regions of the Commonwealth.

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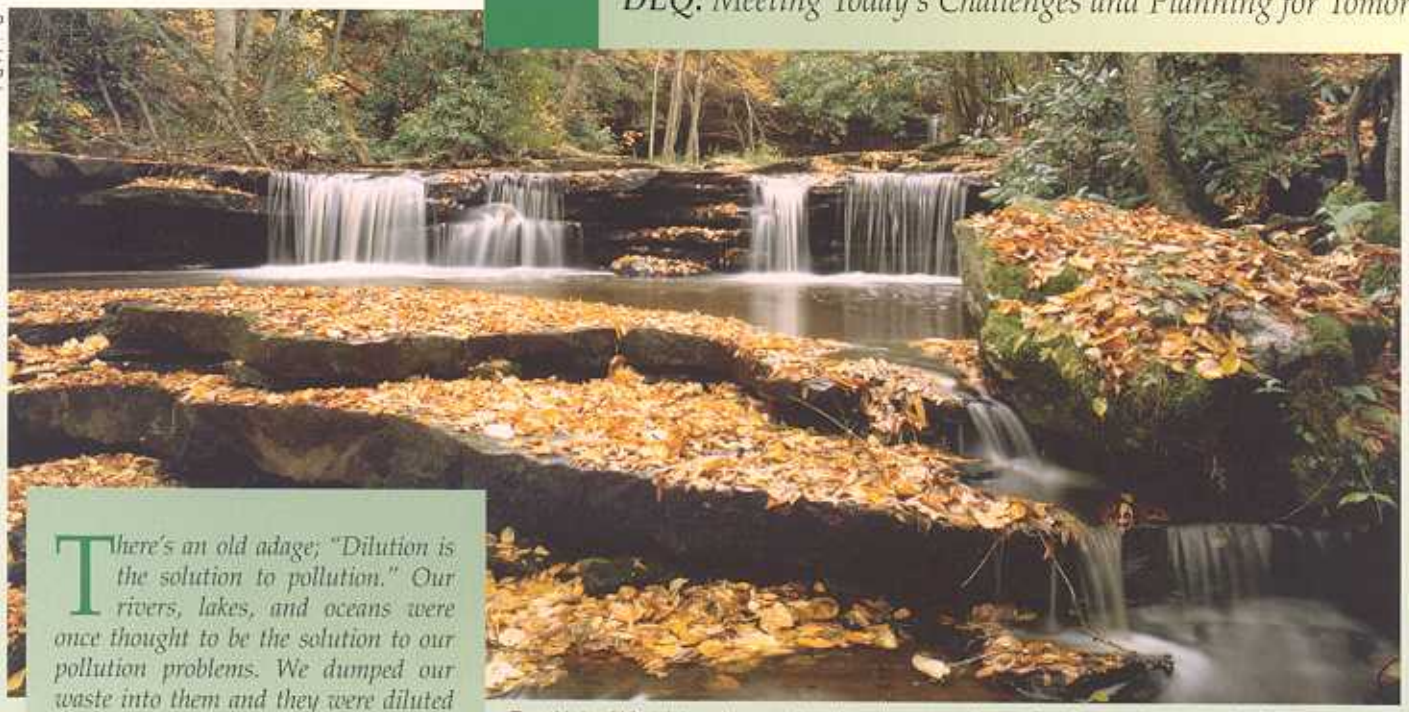
DEQ: Meeting Today's Challenges and Planning for Tomorrow

Dwight Dyke



Two-thirds of Virginia's water runs down from the mountains to the valleys on its way to the Chesapeake Bay.

There's an old adage; "Dilution is the solution to pollution." Our rivers, lakes, and oceans were once thought to be the solution to our pollution problems. We dumped our waste into them and they were diluted and carried out of sight. Cities pumped sewage from homes and businesses into rivers and streams. Factories sent water that had been used in manufacturing processes, untreated, into water bodies. Something had to be done.

In 1946, Virginia was one of the first states to establish a permit program to track discharges into state waters. In 1972 the Clean Water Act was passed to help protect our waters. Using the new law, water treatment technology, education, and a lot of money, we began to tackle our water pollution problems.

Today, environmental scientists are working on ways to prevent pollution from happening in the first place rather than having to treat the effluent after production. Businesses, schools, and individuals across Virginia are adopting pollution prevention techniques such as choosing less harmful products and segregating wastes. Remember, an ounce of prevention means cleaner water for all Virginians.

Virginia's New Water Quality Program

Approximately 1,500 miles of Virginia's streams and rivers are impaired, meaning they don't meet state water quality standards. What pollutant is most responsible? A) toxic chemicals, B) fecal coliform, or C) fertilizers? If you guessed B, you're right! What's the source? Well, in some cases, it's not clear. Over the next 12 years, under the terms of the federal Clean Water Act, Virginia will be developing water improvement plans for 250 polluted streams. New technology and regulations have helped to reduce point source pollution. But nonpoint source pollutants have not been regulated and are not easily quantified. The first step will be to identify both point and nonpoint sources of contamination. Next, a total maximum daily load (TMDL) for each stream will be established. TMDL is the amount of a pollutant that a water body can receive daily and still meet water quality standards and support designated uses like fishing or swimming.

TMDLs are calculated by considering point sources, nonpoint sources, and a margin of safety. DEQ's TMDL program, as it takes into consideration both point and nonpoint sources of pollution for the first time, will result in an overall improvement in water quality in Virginia.

For more information about water quality standards or impaired waters, contact DEQ at (804) 698-4471 or visit www.deq.virginia.gov/wqs or http://gisweb.deq.virginia.gov.

Watershed Planning

Virginia's Tributary Strategy Program is a watershed-based water quality initiative designed to reduce nutrients and sediments that reach Virginia's Chesapeake Bay and tidal tributaries. The purpose of this voluntary, cooperative program is to reach out to all water resources stakeholders including local government officials, farmers, sewage treatment plant owners, and businesses, and ask them to participate in improving water quality in their watershed and in their local streams and rivers.

Tributary strategies are water quality plans that address the specific needs, circumstances, and water quality issues in each tributary basin. The main focus is on surface water transport of nutrients, but since the United States Geological Survey estimates that approximately 50 percent of stream flow comes from ground water sources, future plans will try to address ground water sources as well.

These plans are designed to help citizens within a tributary basin learn more about how they can implement cost-effective practices for nutrient and sediment reduction and how they can become involved in improving water quality.

Virginia's Tributary Strategy Program has already achieved strong success in the Potomac and Shenandoah River watersheds as a result of the Tributary Strategy produced in 1996. Point and nonpoint source nutrient-reduction actions taken in those watersheds as a result of this strategy are very quickly approaching the Chesapeake Bay Program 40 percent reduction goal for phosphorus and nitrogen from that part of the watershed.

Tributary strategies are being finalized for the Rappahannock, York, and James rivers, as well as the small creeks and bays of Virginia's Eastern Shore. These strategies are each unique, representing the different circumstances present in each basin.

It is anticipated that these strategies will be as successful as the Shenandoah and Potomac Tributary Strategy at achieving water quality measures and improving conditions in each respective tributary. Achieving the 40 percent reduction goal is an important commitment that has been undertaken by all signatories of the Chesapeake Bay Agreement, and is expected to lead to major improvements in the Bay's water quality.

Water Pollution Issues in the Chesapeake Bay

The most widespread water quality problem in the Chesapeake Bay is nutrient over-enrichment. Too many nutrients coming from sewage treatment plants in need of upgrades, agricultural runoff, lawn fertilizers, and animal waste are flowing from the land into Virginia's waters. Excess levels of nutrients (particularly nitrogen and phosphorus) lead to blooms of algae at and near the surface of tidal rivers and the main stem of the Chesapeake Bay. When algae die as a result of their normal life cycle, they sink to the bottom and are decomposed there by bacteria. This decomposition consumes oxygen and leads to severe conditions of hypoxia (water with less than 1 mg/liter of dissolved oxygen) and even anoxia (water with no oxygen). This condition has the greatest impact on habitat and living resources in the Bay that need certain levels of oxygen to survive.

Anoxia and hypoxia are severe in certain portions of Virginia's Bay waters. Approximately three-quarters of the total volume of anoxic water present in all of Virginia's Bay waters each year is found in the lower Rappahannock River. The lower York River also contains anoxic water, as do areas within the main stem of the Bay.

Two major categories of nutrient sources affect the Chesapeake Bay and Virginia's tidal tributaries: point sources and nonpoint sources. Point sources refer to excess nutrients that come from old-style sewage treatment plants and, to a lesser degree, food processing plants. Nonpoint sources refer to nutrients that are carried by surface water runoff and ground water discharge from farms, residential lawns, and even forests. As population grows and land is developed across the Chesapeake Bay watershed, these changes will lead to increases in nutrient loads unless more reduction measures are taken. Implementation of these measures, such as agricultural conservation practices, installation of biological nutrient removal at sewage treatment plants, and decreased fertilizer application on residential lawns, is a main focus of Virginia's water quality initiatives.

Water quality conditions are improving in many areas of the Bay and its tributaries as a result of these practices. It is expected that the reduction of nitrogen and phosphorus concentrations will continue and the increase in water quality and habitat will lead to the recovery of a number of fisheries and shellfisheries throughout Virginia's Bay and tidal tributaries.

Chesapeake Bay Foundation

Sailing in the Chesapeake Bay.

Businesses for the Bay

Businesses for the Bay is the Chesapeake Bay's voluntary pollution prevention program. Since the program began in 1996, over 250 facilities, ranging from marinas and gas stations to utilities and chemical manufacturers, have proven that good business practices can also be good for the Bay. In 1998, participants prevented more than 222 million pounds of waste from entering the Chesapeake Bay watershed by implementing a variety of pollution prevention activities. These activities included developing preventive maintenance programs, improving procurement practices, using alternative, less-toxic products, and modifying manufacturing processes. How was this good for business? As a result of these efforts, participants saved over $1.4 million!

However, most businesses don't want to stop there. They want to teach others how they can be a part of this win-win proposition, too. To date, more than 80 individuals have volunteered to share their knowledge and success stories with other businesses that may lack the resources or the technical expertise needed to prevent pollution at their facility.

BUSINESSES FOR THE BAY

Dwight Dyke

Researching water laws and regulations.

Clean Water Act

In 1972, the U.S. Congress enacted the first comprehensive national clean water legislation in response to growing public concern about widespread water pollution. The Clean Water Act (CWA) is the primary federal law that protects our nation's waters with the ultimate objective of restoring and maintaining water quality. This objective translates into two fundamental national goals: eliminate the discharge of pollutants into the nation's waters and achieve water quality levels that make those waters fishable and swimmable.

The CWA provides states with a comprehensive framework of standards, technical tools, and financial assistance to address the many causes of pollution and poor water quality, including industrial and municipal wastewater discharges, polluted runoff from rural and urban areas, and habitat destruction.

The federal act mandates a planning/action protocol for the states to use for cleaning up the nation's waters. The protocol is basically:

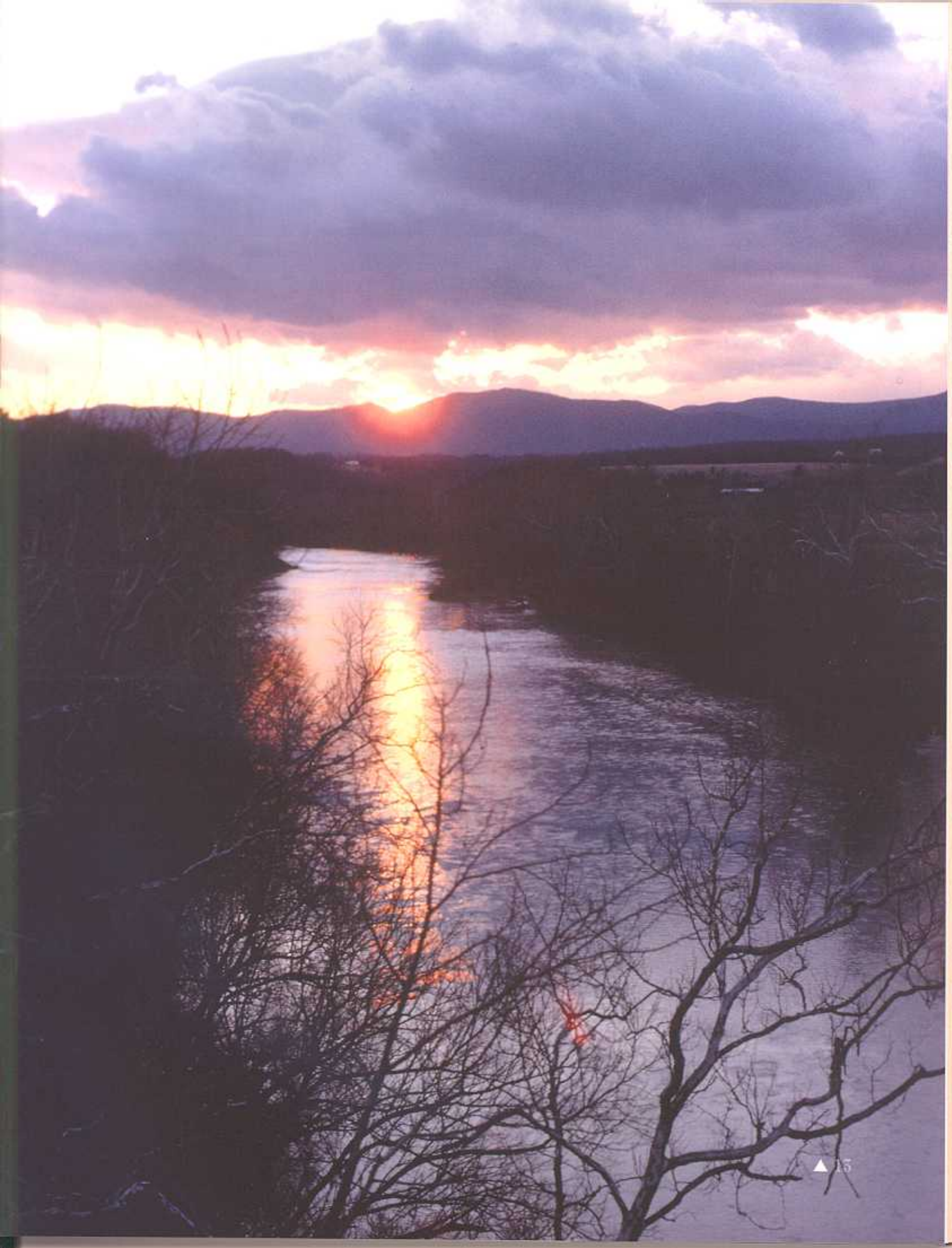
- Adopt water quality standards that assign beneficial uses to particular waters and establish limits on the concentration of pollutants acceptable for such uses.
- Gather data to demonstrate whether the water quality standards are being attained.
- Identify and rank the waters that fail to meet the standards so that the worst problems can be addressed first.
- Produce water quality management plans to determine how much of a pollutant can be safely discharged in a given waterway.
- Implement the plans by issuance of permits that require reduction in the amount of discharged pollutants so standards will be attained.

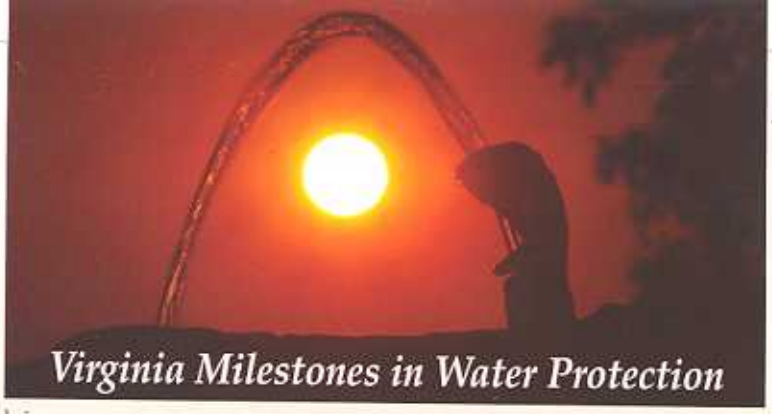
In Virginia, there are several permits that control the disposal of pollutants or otherwise protect the water resources of the state. These permits are:

- Virginia Pollutant Discharge Elimination System permit (VPDES)
- Virginia Pollution Abatement permit (VPA)
- Virginia Water Protection permit (VWP)
- Corrective Action Plan permit (CAP)
- Ground Water Withdrawal permit
- Surface Water Withdrawal permit

More information on regulations governing these permits can be found at DEQ's website, www.deq.virginia.gov.

Above: *Fly-fishing for trout.*
To right: *View of the Shenandoah River and Massanutten Mountain from the George Washington National Forest. Photos by Rob Simpson.*





Rob Simpson

Virginia Milestones in Water Protection

1944 The Virginia Advisory Legislative Council is established to reduce the Commonwealth's stream pollution.

1946 Virginia becomes one of the first states to establish a permit program to track dischargers to state waters, a precursor of today's Virginia Pollutant Discharge Elimination System (VPDES).

1946 The enactment of the State Water Control Law leads to the creation of the Virginia State Water Control Board.

Jean Fogle

1955 Westvaco's Virginia facility voluntarily installs first full-scale waste water treatment plant in the world at a paper mill, reducing its water pollution by 92%.

1965 The Water Quality Standards Act, which requires the development of standards for interstate waters, results in the creation of the Federal Water Pollution Control Association.

David Liebman

1972 The Clean Water Act, the primary federal law that protects our nation's waters, is passed.

1973 The Ground Water Act is established to manage certain large withdrawals in designated ground water management areas to prevent adverse impacts due to overutilization of the resource.

1977 The U.S. Congress directs the EPA to launch a major study to investigate the causes of the Chesapeake Bay's environmental decline.

1983 The Chesapeake Bay Agreement is signed in an attempt to develop and implement coordinated plans to improve and protect the water quality and living resources of the Chesapeake Bay estuarine system.

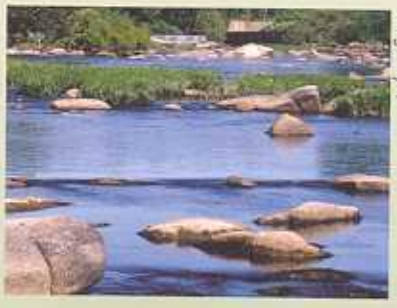
1987 The Chesapeake Bay Agreement is expanded to address a variety of impacts to the Chesapeake Bay estuary and to set in motion specific actions to be taken by each of the signatories.

1987 The Ground Water Protection Strategy for Virginia is developed as a mechanism to stimulate, strengthen, and coordinate ground water protection activities in the Commonwealth.

1988 Passage of the Chesapeake Bay Preservation Act.

1993 DEQ is established by merging the State Water Control Board, the Department of Air Pollution Control, the Department of Waste Management, and the Council on the Environment.

1996 The first Tier III water, or "Exceptional Water" ranking, was adopted by the State Water Control Board at North Creek in Botetourt County.



Dwight Dyke

1997 The Water Quality Improvement Act establishes a grant program to implement nutrient reduction projects.

2000 The Virginia Nontidal Wetlands Act is established to ensure protection of state wetlands.

2003 The General Assembly passes legislation to require development of comprehensive water supply planning at state, regional, and local levels.

Dwight Dyke

2003 The State Water Control Board authorizes $179 million in loans to local governments for the enhancement of wastewater treatment plants and collection systems to improve water quality.

1944-2003

Water Scenes

Courtesy of Dunwood Usry

Virginia's waterways have been used through the centuries for transportation and recreation.

Dwight Dyke

Canoeing on the Maury River.

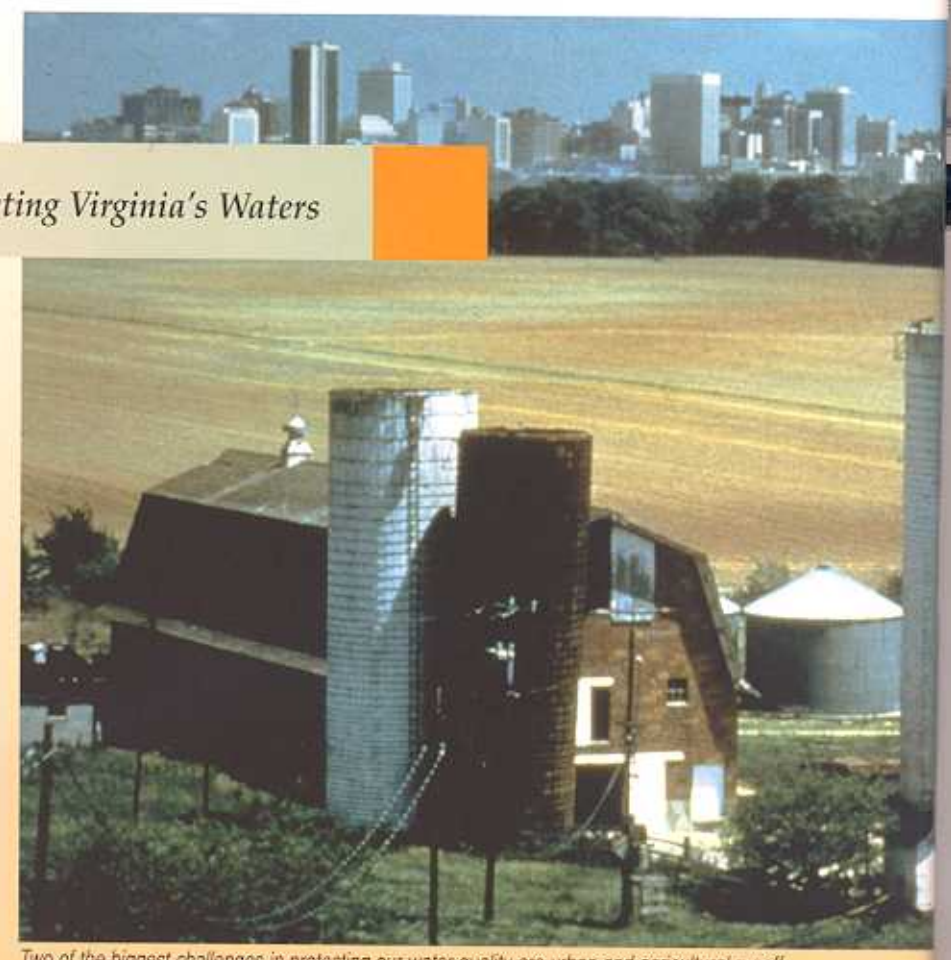
Dwight Dyke

Birdwatching.

Virginia Division of Tourism

Snow-capped rocks along a riverbed.

New Technology and Science of Protecting Virginia's Waters



Two of the biggest challenges in protecting our water quality are urban and agricultural runoff.

Historically our rivers have been used as conduits for travel and commerce. Unfortunately, they also have been the recipients of industrial and domestic waste. The discharge of domestic wastes can poison surface water and make it impossible to use some of our water resources.

In the 1940s, when Virginians realized that their waters were becoming polluted, they began tracking discharges to the water. Later, in the 1960s, Virginia and the federal government began developing water quality standards.

DEQ is responsible for assessing the quality of water, setting acceptable standards, monitoring for changes, and recommending water quality improvement practices. Much of this is done through the Water Quality Standards Program.

These standards are adopted by the state to protect aquatic life and public health and welfare to enhance water quality, and to meet the purposes of the Clean Water Act. The standards define the water quality goals of a water body by designating the water's uses, by setting criteria to protect these uses, and by preventing degradation of water quality through antidegradation provisions.

Standards are adopted for all "waters of the United States." This federal definition encompasses a broad range of waters, including rivers, streams, seasonally flowing streams, lakes, natural ponds, wetlands, and marine waters. Marine waters include estuaries, salt marshes, lagoons, and near-shore coastal waters.

The federal definition does not include ground water. However, since state waters in Virginia are defined by state statute as "all waters above and below the ground," Virginia has water quality standards for both surface water and ground water.

Water quality criteria are either narrative or numeric in nature. Narrative criteria describe the desired condition, such as the waters should be free from toxic pollutants in toxic amounts. When enough information is available to determine a safe concentration of a specific chemical, a numeric criterion can be adopted.

Water quality criteria have been adopted that reflect normal levels of pollutants, dissolved oxygen, temperature, and acidity. These criteria will protect aquatic life and reflect different needs for different species. For example, trout require a greater concentration of oxygen and lower temperatures for their eggs to hatch successfully, so the criteria that apply to trout waters reflect these requirements.

Concentrations of a chemical at or below its criterion will allow a well-balanced community of aquatic life to live, grow, and reproduce. Criteria for toxic pollutants are expressed in concentrations of micrograms per liter of water, or sometimes as the equivalent "parts per billion (ppb)."

There are two types of water quality criteria: aquatic life and human health. The aquatic life criteria protect

Dwight Dyke

DEQ engineers evaluate the latest equipment and processes at wastewater treatment plants.

Courtesy of USDA

fish and aquatic invertebrates. Human health criteria are designed to protect humans from potentially harmful effects that could be caused by drinking polluted water or eating fish from polluted water bodies. These criteria are designed to prevent fish and shellfish from concentrating toxic chemicals to levels that could prove harmful to people who eat them. Different criteria are used in public water supplies where people could be exposed to contamination in both the drinking water and through catching and eating fish.

Chemical criteria alone are inadequate to characterize fully the physical and biological integrity of our waters or the reductions in risk necessary to attain the goals of the Clean Water Act. The EPA is developing methodologies and criteria beyond the traditional chemical-specific type criteria to protect wildlife, wetlands, and sediment quality; biological criteria for better definition of desired biological communities in aquatic ecosystems; and nutrient criteria.

State water quality standards play a central role in a state's water quality management program.

Surface Water Monitoring Programs

DEQ monitors 1,648 stations throughout the state to determine water quality trends and conditions for identification and ranking of Virginia's priority water bodies. These stations include 1,349 ambient water quality stations and about 200 biological monitoring stations. Stations are located to gather information from industrial, urban, rural, and undeveloped areas of the state. These data are gathered near industrial and municipal discharges, nonpoint source areas, public water supplies, unaffected areas, and previously unassessed areas. In this way, stream miles at risk from major pollution sources are well-documented, as are those where pollution risk is suspected or unknown.

Sites are carefully selected by DEQ engineers. Samples collected include water, sediment, fish tissue, and bottom-dwelling organisms. One-third of these stations are also monitored for toxics in the water column or in the sediments. Areas with potentially greater risk are sampled more frequently, with more types of samples being collected.

DEQ's monitoring effort includes statewide surface monitoring, Chesapeake Bay tributary monitoring, fish tissue monitoring, and aquatic insect sampling in streams. DEQ collects approximately 39,000 samples every five years. All data collected by DEQ are subjected to a Quality Assurance Quality Control Program.

Stuart Torbeck

Testing for water quality.

What is the Water Quality Assessment Report?

Ever wonder how clean our streams, lakes, and estuaries are in Virginia? The best compilation of water quality data and water quality assessments can be found in the biennial report to the EPA, named the *305(b) Water Quality Assessment Report* for section 305(b) of the Clean Water Act. This report includes general information about Virginia's water resources and water quality assessments by river basin. It also refers to the designated uses of the waters defined by DEQ's water quality standards. These uses include aquatic life, fish and shellfish consumption, swimming, and public water supply. Our website is www.deq.virginia.gov/watermonitoring.

A Bug's Life Tells Stream Health

Since 1978 DEQ's biological monitoring program has used benthic, or bottom dwelling, organisms in wadable streams and rivers as indicators of the health of the water's biological community. Changes in water quality will generally result in changes in the aquatic ecosystem. Likewise, differences in aquatic community structure are reflective of changes in water quality. The types and numbers of insects and other macroinvertebrates (organisms without a backbone that are large enough to be seen with the naked eye) found in a water body are indicative of the quality of that water body. DEQ currently monitors approximately 200 sites twice a year under this program. Like chemical water quality monitoring data, biological monitoring data are used to assess whether the current water quality supports the designated uses specified in the water quality standards regulation for that water body and the Clean Water Act fishable and swimmable goals.

David Liebman

David Liebman

Black-faced skimmer (above) and white-tail dragonfly (below).

Dragonfly larvae.

The purpose of these biological evaluations is to define water quality by examining the community structure of benthic macroinvertebrates. The majority of the freshwater benthic macroinvertebrates found in Virginia come from four general groups: insects (adults and larvae), mollusks, crustaceans, and annelid worms. These organisms are important to water quality studies for several reasons. In addition to being the major intermediate constituent of the aquatic food web, benthic macroinvertebrates are considered virtual living recorders of both past and present water quality conditions. This is due to their relative immobility and their variable resistance to the diverse contaminants introduced into streams. No two groups of benthic organisms have the same resistance to the various chemical and physical conditions encountered in the aquatic ecosystem. An evaluation of the community structure of these organisms provides the basis for the biological analysis of water quality.

Rob Simpson

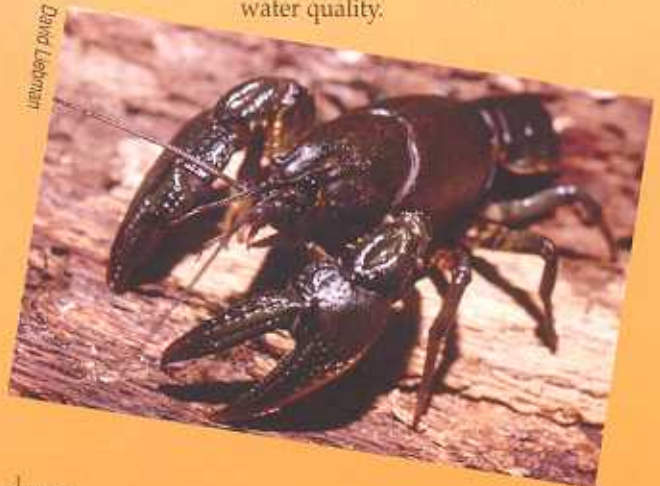
Stonefly.

Rob Simpson

Close-up of Eastern Dobsonfly.

David Liebman

Two pond snails and offspring.



David Liebman

Crayfish.

Rob Simpson

Fish can accumulate chemicals in their tissue by ingesting pollutants that are discharged into streams and rivers.

What Has This Fish Been Eating?

Virginia offers a wide variety of fishing opportunities from its beautiful lakes and streams in the Appalachian and Blue Ridge mountains to the majestic Chesapeake Bay. However, after reeling in their prized catch, anglers may ask, "Is this fish healthy?" Some pollutants bioaccumulate or biomagnify in concentration as they pass through aquatic food chains. A simple example of how the biomagnification process works would be as follows. First, imagine a water body with one part per billion of a certain contaminant in the sediment.

Water contaminants are measured and reported in parts per million (ppm), parts per billion (ppb), and parts per trillion. Although these may seem extremely small concentrations, the toxicity of many chemicals can cause health problems above these levels. People can smell petroleum products in water at concentrations as low as 10 parts per billion. This low concentration could also be represented as one drop of water in an Olympic-sized swimming pool, one pinch of salt in 10 tons of potato chips, one cent in $10,000,000, one inch in 16,000 miles, or one bad apple in 2,000,000 barrels!

Imagine that minnows feeding on food items associated with the sediments absorb 10 ppb of the contaminant into their tissue. If a predatory fish such as a bass eats 10 of the minnows, the contaminant concentration in the bass may increase to 100 ppb (10 x 10=100). If an angler eats 10 bass, the contaminant level in the angler may become 1,000 ppb (10 x 100=1,000). It is easy to see how low concentrations of certain contaminants released into the environment may eventually cause detrimental effects to organisms that consume the contaminant, including humans.

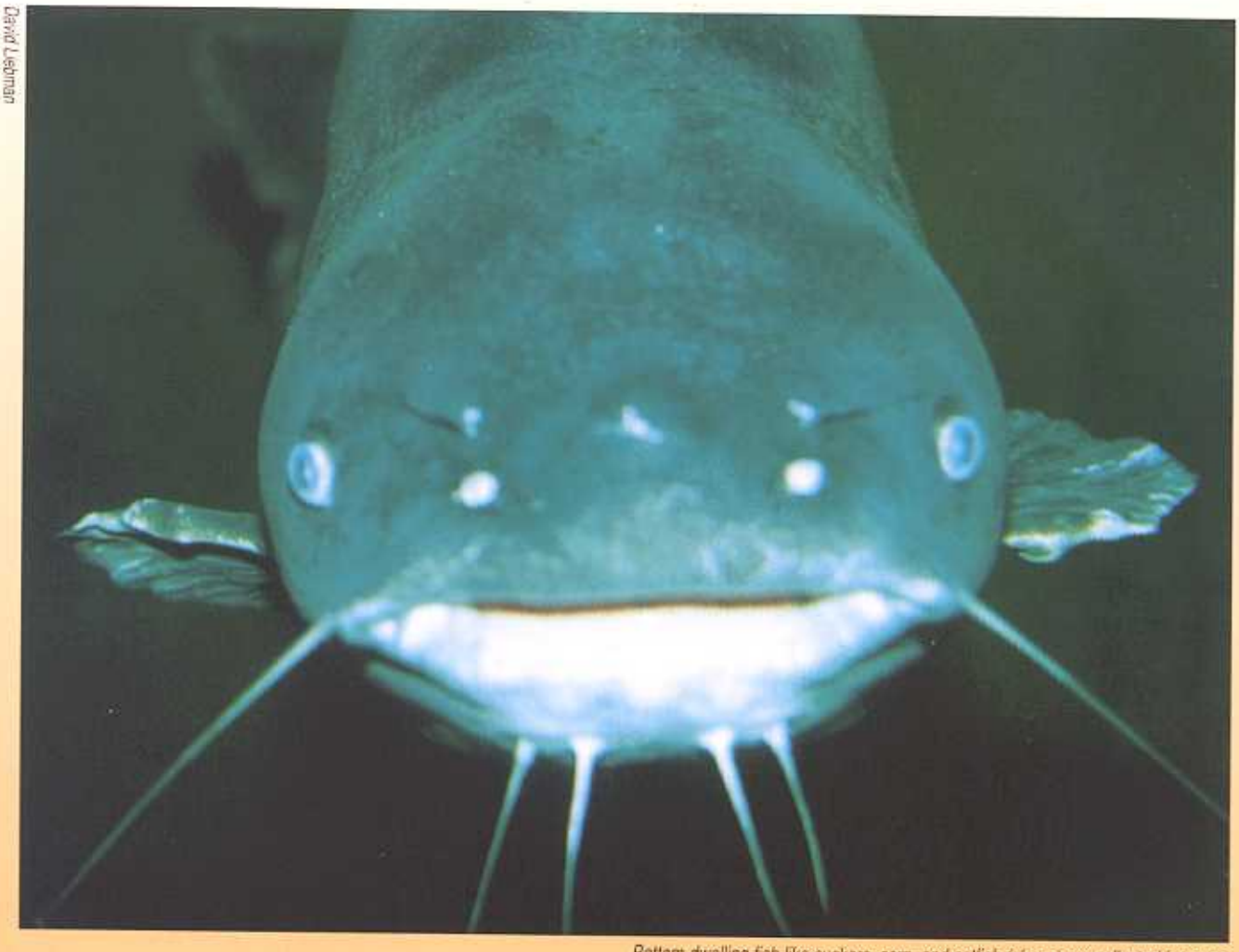
Many compounds that tend to bioaccumulate, such as the insecticide DDT, were banned for use in the United States in the mid-1970s. However, some of these contaminants deteriorate very slowly and are still present in the environment today. To address these concerns, DEQ conducts routine studies of fish and shellfish tissue and sediment samples to assess and communicate the risks of contaminants in the aquatic environment.

The primary objectives of the program are to collect the data required to assess the human health risks for individuals who may consume fish from state waters and to identify impaired aquatic ecosystems. Approximately 30 to 40 stations are selected among two river basins per year.

Richard Browder

DEQ field technicians use electroshock fishing to collect fish for tissue sampling.

David Liebman



Bottom-dwelling fish like suckers, carp, and catfish (above) are collected because they are most likely to come in contact with contaminants in sediment.

A predator from high on the food chain (such as a largemouth bass), a mid-level predator (e.g., bluegill), and a bottom feeder (e.g., catfish species) are usually targeted first. Adult fish are collected because their potential for exposure to environmental contamination has occurred over a longer period of time compared to juvenile fish. Five to ten fish of each target species are typically collected using electrofishing equipment. This equipment can be transported on a boat for large streams and lakes or on a backpack unit for smaller wadable streams. It is used to apply an electrical charge to the water that momentarily stuns the fish, allowing for easy netting. Gill nets and fish traps are also used to catch the fish. Mobile shellfish such as crabs are usually collected in baited crab pots. Sedentary shellfish such as oysters may be dredged or dug up by hand.

Each fish or shellfish collected is weighed and measured, wrapped in aluminum foil, and placed in a labeled plastic bag. Sediment samples are also collected with a dredge or hand scoop. Both the fish and sediment samples are frozen until they are processed by the contract laboratory. The laboratory removes edible tissue of fish or shellfish of the same species and combines the tissue to make a species-specific composite sample. The tissue and sediment samples are analyzed for heavy metals, pesticides, and trace organic compounds. The results are analyzed and compared to state and federal screening values to calculate the risk to human health.

If these results indicate toxicity levels have been exceeded, an intensive investigation may be conducted. Investigations typically involve laboratory analysis of five to ten individual filet samples or multiple composite samples of two or three top or mid-level feeders and one or two bottom-level feeders at each station to increase statistical power.

After the fish tissue and sediment data are analyzed, reports are distributed to the Virginia Department of Health which assess the data and issues fish consumption bans or advisories if necessary. In addition, reports are sent to the appropriate DEQ central and regional offices where they are used by water quality managers to help identify areas of impairment. Analytical results for contaminants in sediment are compared to screening values provided by the National Oceanic and Atmospheric Administration to assess the potential effects of sediment contamination to aquatic life.

Using GIS to Make Informed Environmental Decisions

What is a Geographic Information System (GIS)? Simply stated, it is the use of a computer to display information in multiple layers on a map. It allows you to decide what you want to look at and how you want to evaluate the information. User-friendly applications can be developed to help the public understand environmental issues and programs.

DEQ is using GIS in many ways in water resource planning and management and to provide the public with greater access to information. These products are used by state agencies, industry, and the citizens of Virginia in discussions of environmental issues and in water quality remediation efforts.

DEQ is also providing the public with access to GIS through its online Geographic Environmental Mapping System http://gisweb.deq.virginia.gov. This web site allows the public to explore environmental data through an interactive map and provides links to allow users to retrieve additional information from databases maintained by DEQ. Currently this site hosts data from various programs throughout the agency. As additional data is developed, they will be added to the interactive mapping site.

GIS mapping displays multiple layers of information.

Rob Simpson

DNA Fingerprinting: Tracking Pollution at Its Source

Using the latest developments in biotechnology, DEQ is piloting studies to determine the species of mammals contributing significant quantities of bacterial pollution in our more highly impaired surface waters. The sequencing of DNA patterns, known as DNA fingerprinting, is a technique that determines the arrangement of selected segments of the DNA molecule. The technique can be used to distinguish very small differences, as between siblings, or big differences, as between animal species.

Armed with this information, cleanup strategies can be targeted at the specific cause of excessive bacteria. For example, if the bacteria present in a watershed are human in origin, cleanup can be focused on failed septic tanks or untreated wastewater discharges.

DNA fingerprinting can determine the source of bacterial pollution from different animal species.

Virginia Water Resources Research Center

When petroleum releases from storage tanks contaminate residential wells, the Virginia Underground Petroleum Storage Tank Fund, administered by the DEQ Office of Spill Remediation, may be accessed to provide an alternate water supply, including drilling a new well.

Petroleum Contamination– Where's the Leaky Tank?

With over 15,000 petroleum contaminated sites reported since 1988, property owners and prospective buyers often ask DEQ whether there have been any petroleum releases on or near the property of interest. Until recently, the best way to assist citizens in finding nearby contaminated sites was to list contamination sites with the same zip code. In most cases this produces a long list of contaminated sites that must be located on a map. GIS is ideal for displaying these sites. With the help of the EPA, the Virginia Department of Transportation, and the Virginia Economic Development Partnership, DEQ is developing a GIS that the public can use to identify all petroleum-contaminated sites within an area of interest. It is a simple as pointing and clicking a mouse!

The system uses two screens. In the first screen the user simply selects the county of interest. This brings up the second screen, which allows the user to move around the county in a detailed view that displays contaminated sites on a road map. The user has the ability to zoom in or out, identify sites within a measured radius, print a detailed map showing contamination sites of interest, and print a summary report identifying site locations.

One word of caution! The system is designed to give the user a "short list" of sites. If information is needed on the extent of contamination or the risk to human health and the environment, concerned citizens must review individual site files or discuss concerns about a site with the DEQ regional staff geologists.

Lyn Sharp

Scientists perform a variety of tests to check water quality and the general state of the river.

Water Quality: How Clean is It?

Using DEQ and citizen monitoring data from Izaak Walton's Save Our Streams program, Friends of the Rivers of Virginia and the Alliance for the Chesapeake Bay, DEQ develops water quality maps for the entire state.

Information about water quality monitoring and location of impaired (polluted) streams segments is displayed. DEQ coordinates with Virginia Geographic Information Network to gather other information layers such as road and bridge locations.

DEQ is developing maps for use on the Internet to provide high quality environmental information to citizens 24 hours a day, 365 days a year.

DEQ
VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY

Dwight Dyke

Everyone enjoys clean water!

Working Together for Clean Water

Taking care of Virginia's waters is a big job. That's why DEQ has teamed up with a variety of partners to get the job done. DEQ, other state agencies, local governments, businesses, citizen groups, and the U.S. EPA all work together to maintain and improve water quality in Virginia and accomplish the goals of the Clean Water Act.

Once water quality standards are set by state and federal agencies, permits must be written and enforced. DEQ provides technical assistance to facilities to help them comply with state and federal water quality laws and meet their permit requirements. Many businesses and local governments in Virginia have decided to go "beyond compliance" and stop pollution before it starts. DEQ is proud to help these facilities design pollution prevention programs and keep abreast of the latest innovations in water quality technology. The following articles highlight DEQ's unique partnership efforts to protect and enhance the waters of Virginia.

Trained Operators Ensure Safe Water

A large portion of the waste disposed into Virginia's waters is generated at wastewater (sewage) treatment plants. The plant operator is the key element in protecting the citizens and the environment of the Commonwealth. The operator of a wastewater treatment facility must have knowledge in many different areas and be licensed before he can perform these duties. Scientific disciplines such as water chemistry, microbiology, and hydraulics, are used to evaluate and control the treatment processes. The plant operator collects and analyzes samples to determine discharge quality, maintains plant equipment, and performs the administrative activities necessary to ensure plant compliance with a variety of state and federal environmental and safety laws and regulations.

To assist in the licensing process, the DEQ Office of Operator Training, in cooperation with Virginia Tech, selected community colleges, vocational centers, and professional associations, develops and conducts specialized training programs for both entry-level personnel and those wishing to obtain higher-level licenses. Close to 500 operators and operator trainees participate in these programs each year.

The Office of Operator Training also conducts in-service professional development workshops for operators and other treatment plant personnel. These workshops are designed to update or refresh existing skills and provide additional new skills necessary to comply with new, more stringent water quality requirements. Lasting from one to three days, these in-service workshops cover a single topic such as proper procedures for sampling and analyzing a pollutant or recommended procedures for the operation and maintenance of a specific treatment process.

The small treatment plant has very limited resources available to evaluate plant performance, identify problems, and develop cost-effective solutions. Assistance provided in these areas can mean the difference between a high-quality clean water discharge and one that poses a serious threat to public health and the environment. DEQ, through its Office of Operator Training, provides this assistance and "over-the-shoulder" training to small wastewater treatment plants between 200 and 300 times each year.

Dwight Dyke

Water testing is done periodically by DEQ personnel.

The Office of Operator Training provides more in-depth assistance to a small number of facilities annually. This assistance begins with a comprehensive evaluation of the operation and the management, maintenance, and design of the plant. DEQ staff uses this evaluation to identify specific issues that must be addressed to improve plant performance or compliance. An action plan is then developed to correct identified problems, implement sound operating and management procedures, and optimize the cost-effective operation of the plant.

Once the plan is completed, DEQ works with plant personnel to implement recommendations. DEQ conducts its on-site activities over a three- to 12-month period to allow sufficient time to implement the recommendations and to identify and address any additional problems. Throughout the project, DEQ monitors activities and adjusts the action plan to assist the plant staff in achieving the highest quality water discharge by the most cost-effective methods.

Petroleum Storage Tanks: Don't Underestimate Underground Pollution Problems

> *"Water, water everywhere,*
> *nor any drop to drink."*
> —Rhyme of the Ancient Mariner

There are thousands of gasoline stations and petroleum storage facilities throughout Virginia that store their fuels in underground storage tanks. Since 1988, over 15,000 locations with leaking petroleum storage tanks have been reported to DEQ. No one who owns a petroleum storage tank intends to have a leak that contaminates ground water, but it does happen. These leaking tanks range from the 250-gallon home-heating oil tank to the major distributing facility with over a million gallons of underground and above-ground storage tank capacity.

Jean Fogle

Abandoned gas pumps could spell trouble for our ground water.

Monday, August 23, 1999, 8:30 a.m. at DEQ's central office. The telephone rings:

"Hey John, good morning."

"Good morning, Todd. What can I do for you?"

"I got a call on Friday afternoon. A couple out in Fluvanna County, the Chambers, told me their well water has had a petroleum odor in it since sometime last week. They said it was barely noticeable at first. The odor would come and go, but then it started getting stronger each day. I went out to their house and could definitely smell something in their water. I would say they have some type of petroleum contamination."

Such has been the story for approximately 400 Virginia households since the inception of DEQ's Alternate Water Supply Program in January 1990. Prior to the existence of the program, there was little help for people with petroleum-contaminated water wells. Now when petroleum contamination is suspected, DEQ directs its filtration contractor to perform an assessment of a suspected drinking water problem. Water samples are collected to see if contamination is present, to measure its concentration, and to determine its type. The presence of benzene, toluene, ethylbenzene, xylenes (BTEX), and/or methyl tert-butyl ether (MTBE) typically signify gasoline contamination. The first four compounds listed above are standard petroleum components of gasoline. The fifth compound, MTBE, is a highly soluble gasoline additive that came into common use in the 1980s.

When it comes to cleaning up petroleum contamination, DEQ takes a very practical approach.

For petroleum contamination, the immediate fix is straightforward. A filtration system will be installed that uses granular activated carbon, a material that resembles extremely coarse coffee grounds. The activated carbon acts as a chemical magnet, attracting molecules ranging from naturally occurring dissolved minerals to petroleum contamination. As the contaminated well water flows through the activated carbon filters, the contaminant molecules bind to the surface of the activated carbon, purifying the water now exiting the filtration tanks.

Carbon has a finite life span and is viewed by DEQ as a temporary solution to petroleum-contaminated water supplies. In most cases, the long-term solution to a contaminated water well is the installation of a replacement well. The difficulty with replacement wells comes in securing a new well location that yields the best probability of being contaminant-free. Sometimes a replacement well becomes contaminated weeks, months, or even years after first use.

The ideal alternate water supply is a connection to a municipal water supply. Municipal water supplies are public water supplies that are regulated by the Virginia Department of Health (VDH). This means the VDH requires periodic sampling of the water supply for bacterial and chemical contaminants. If contamination is detected, the public water supply is required to take actions to mitigate the contamination.

At the same time the DEQ is coordinating the alternate water supply, DEQ regional geologists investigate the release, determine if there is a responsible person, and assess the need for cleanup. DEQ takes a very practical approach when it comes to cleaning up petroleum contamination. Where petroleum contamination poses no risk to human health and the environment, minimal corrective action is required. DEQ ensures the product is removed from the leaking tank(s) and that any spilled product is recovered. If highly contaminated soil is present, DEQ will require removal and proper disposal of these soils.

At sites where the contamination poses a risk to human health or the environment, more extensive cleanup is necessary. For example, if petroleum-contaminated ground water is seeping into a stream, cleanup requirements for the ground water must protect the aquatic life in the stream. If people are expected to come in contact with the stream, the cleanup requirements are more stringent.

David Liebman

Petroleum storage site.

November 16, 1999; 11:05 a.m. at DEQ's central office:

"John, this is Todd. I've got good news."

"You got a replacement well installed at the Chambers' residence?"

"Not only that, but the first set of test results for the new well are back, and they are negative. It looks like we have a clean well."

"That's great. I'll leave the filtration system in place until you have results for a second round of water sampling. When you say the word, we'll have the filtration system removed. I imagine the Chambers are rather pleased with the prospect of having a new and clean well just in time for the holiday season."

Chesapeake Bay Foundation

Clean water is vital to the development and growth of Virginia's oysters, crabs, and fish.

Oysters Help Revive Virginia's Coastal Heritage

The oyster, a keystone species in Virginia's coastal waters, is in trouble. At the peak of Virginia's oyster harvesting heyday in the early 1900s, annual catches exceeded nine million bushels. By 1958, watermen collected about four million bushels. Today, due to many years of disease, pollution and over-harvesting, the total catch of the oyster is less than 1 percent of that number. The habitat, water quality, and economic benefits of thriving oyster populations have nearly been lost to the great detriment of Virginia's coastal ecosystems and economy.

In March 1999, the Virginia Coastal Program at DEQ partnered with the Virginia Marine Resources Commission to establish the Virginia Oyster Heritage Program (VOHP). This collaborative large-scale restoration effort has shepherded over $11 million in funds from federal, state, and private sources. Using the Marine Resources Commission's original design, VOHP reefs are a series of three-dimensional mounds of oyster shells eight to ten feet high. They provide the substrate necessary for oyster settlement and growth. Disease-tolerant oysters are grown off-site and transplanted to the designated reefs. Partners like the Chesapeake Bay Foundation help in these oyster gardening efforts.

Educating the public is another key priority of the VOHP. Thousands of Virginians continue to learn about the critical role oysters play in water quality, biodiversity, and the coastal economy. The private, non-profit Virginia Oyster Reef Heritage Foundation has raised over $100,000 and provides a way to take action for businesses and individuals.

The DEQ and the other VOHP partners are confident that the Program has been a success. They are now helping to create an educated citizenry and ultimately a sustainable fishery that will benefit both the state's economy and its coastal ecosystems.

Chesapeake Bay Foundation

Before: *Sediment and algae can cloud water, preventing sunlight from reaching the bottom.*

Chesapeake Bay Foundation

After: *Oysters can help filter and clarify water. A single adult oyster can clean up to 60 gallons of water a day. Before their decline, the Bay's oysters could filter an amount of water equal to the volume of the entire Bay in three to six days. Today it takes a year or more for our remaining oysters to do the same job.*

Success of the Virginia Oyster Heritage Program

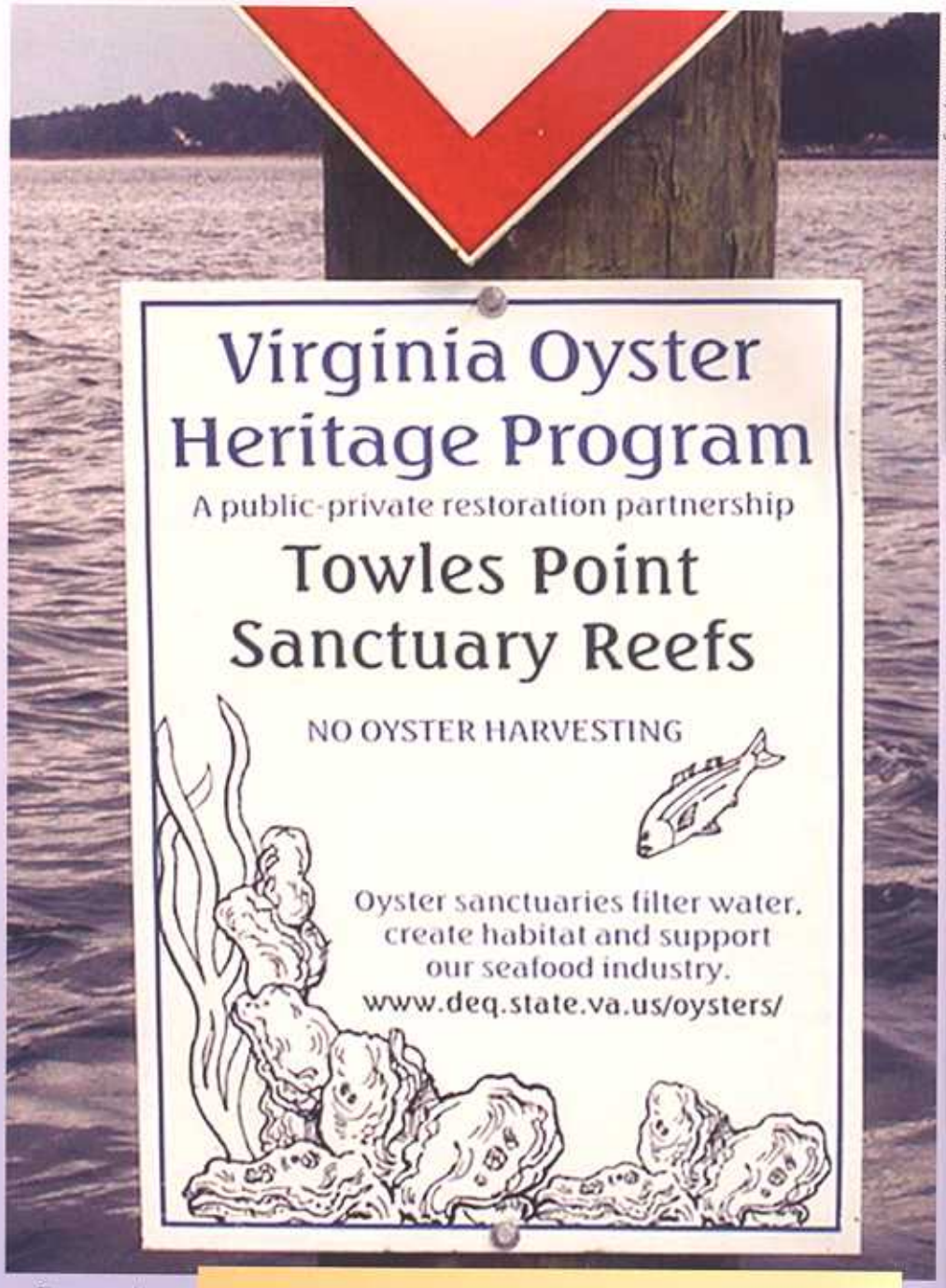
Early monitoring of these sites indicates that oysters are starting the slow process of recovery. To date, the VOHP can see a wide exhibit of accomplishments.

■ Among sites on Virginia's coastal waters, watermen, local governments, and volunteers have built approximately 80 sanctuary reefs and over 1,000 acres of harvest area.

■ On the Rappahannock River, the site of the first phase of the program's efforts, volunteers built 13 sanctuary reefs and more than 500 acres of harvest area in Virginia's coastal waters.

■ Efforts are spreading to Tangier Island on the seaside of Virginia's Eastern Shore. There, volunteers constructed eight reefs and restored over 20 acres of reef by 2002.

■ Other restoration efforts now look at the VOHP for ideas. The Program served as a catalyst for a Bay-wide commitment to increase oyster populations tenfold over the next ten years. It also helped galvanize a 2000 Bay-wide strategy to meet this commitment.



Signage marking an underwater oyster reef at Towles Point on the Rappahannock River.

Help Restore Oyster Reefs to Virginia's Coastal Waters!

■ Donate to the Virginia Oyster Reef Heritage Foundation: visit http://www.deq.virginia.gov/oysters/foundat.html or call (804) 698-4320.

■ Become An Oyster Gardener: visit Chesapeake Bay Foundation at http://www.cbf.org or Virginia Institute of Marine Science at http://www.vims.edu/abc/green/ogp.html.

Boar's Head Provisions Company Case History

The Boar's Head Provisions Company, located near the southern Virginia border in Greensville County, faced a salty groundwater contamination problem that began around 1995. After acquiring a 1,000-acre manufacturing site in the early 1980s, the company revised its operations to begin processing and packaging deli meats (ham, beef, and turkey). The pickling operations that were the key to the new operations were high in salt (sodium chloride) use and generated a salty wastewater that was barely treated by the original treatment system. The plant also increased production, resulting in more water and more salty wastewater.

The original treatment system contained a grease skimmer, screening, a three-million-gallon anaerobic lagoon, a three-million-gallon mechanically aerated lagoon, a 16-million-gallon holding pond, and a 48-acre spray field. In 1998, the wastewater that passed through the treatment system totaled about 62 million gallons or about 250,000 gallons per day. To monitor the salt concentration in the ground water, DEQ sampled shallow wells located around the spray field. Seven wells were strategically installed so that the salt levels could be closely monitored. Starting in 1995, no wells exceeded the 250 milligrams per liter (mg/l) limit provided by the EPA as a drinking water criteria. By 1996, two wells exceeded the criteria, and by 1997 two more wells exceeded the criteria. In December 1997, Well 4 disclosed 700 milligrams per liter of salt as chloride, approaching the raw wastewater concentration of about 950-1000 mg/l as chloride. Fortunately, apart from the Boar's Head wells, there were no drinking water wells in the vicinity of the plant.

To begin the clean-up process, a special consent order was issued in 1998, and DEQ and Boar's Head officials worked together to seek remedies. In the treatment area, the spray site was increased from 46 to about 152 acres, another holding lagoon of 26-million gallons was added, and spray nozzle sizes were widened to allow larger spray droplets. DEQ scientists felt that the larger droplets would minimize evaporation and reduce salt buildup in the soil.

To help prevent pollution Boar's Head re-engineered its plant to prevent pickle wastewater overflows and dripping from the transportation lines. They also eliminated dry salt packing on natural casings and changed the pickle-making sequence to add salt last so that if a bad batch was encountered, no salt would be discharged. To reduce pollution at the source, Boar's Head moved certain product lines to other locations. Disposal efforts included isolating high concentration salt operations, storing the wastewater, and trucking a portion of the salty wastewater to a large municipal treatment system. Additionally, a pipeline was added to shunt-off up to 40, 000 gallons a day of wastewater to a nearby county treatment system. These efforts have cut the raw wastewater salt concentrations in half. Boar's Head hired a consultant to evaluate the effects of these changes and it was predicted that the chloride concentration in the monitoring wells would return to below 250 mg/l within 12 to 18 months. DEQ and Boar's Head continue to work cooperatively to ensure further salt reductions, including continued pollution prevention efforts, and adding more monitoring wells and soil testing on the spray site.

Rob Simpson

The Rose River in Shenandoah National Park.

Jim Regn

These children are learning about the connection between aquatic insects and water quality.

PROJECT WET
Water Education for Teachers

Now It's Up To You!

Water. You count on it to be there every day: drinking water in your tap; clean water in your tub. And so do the close to seven million other people who call Virginia home. How do we ensure that our water resources are available and clean far into the future?

The number one thing you can do to help protect Virginia's waters is to get smart and separate fact from fiction. According to a survey conducted by the National Environmental Education and Training Foundation, two out of three adults flunked a simple test of environmental knowledge.

You've heard of urban legends, those intriguing tales that sound dubious but you want to believe them. Here are some pollution legends. Don't believe a word of them because they aren't true and they are perpetuating some of the problems Virginia is having keeping its waters clean.

MYTH: Factories are the leading water pollution source.
TRUTH: The leading source of water pollution is runoff of fertilizers, household waste, and other nutrients from the land.

MYTH: It doesn't matter how much fertilizer I use on my lawn.
TRUTH: Many people apply fertilizers without having their soil tested first. Most of the applied fertilizer is likely to run off, affecting water resources near your home.

MYTH: It's okay to dump yard waste in a storm drain, stream, or river.
TRUTH: Yard waste can clog storm drains. If it reaches streams or rivers its decay can steal oxygen from the water, choking fish and other organisms.

MYTH: My wastewater is not a problem because my septic system removes the nutrients.
TRUTH: Septic tanks are not designed to remove nitrogen, one of the top pollutants in ground water. Most people don't have their septic tanks maintained or pumped.

MYTH: I don't have to clean up after my dog.
TRUTH: Studies have shown that runoff of pet waste causes major pollution during rainstorms.

MYTH: One person can't really make a difference.
TRUTH: If every person in Virginia made one change, our waters would be a lot cleaner.

Water. You count on it to be there every day...

Here's Where You Come In

Choose to make a difference in Virginia's water quality.

1. **Get involved and become a steward of our water.** Check online at www.dcr.virginia.gov/stewardship for the Virginia Stewardship program, citizen monitoring, and other activities in your area.

2. **Practice good stewardship at home.** Use water wisely when brushing your teeth or doing household chores that require water. Repair leaks—a dripping faucet can waste 20 gallons of water a day and a leaking toilet, 200 gallons! Install low-flow showerheads and take showers rather than baths. Wash cars and water lawns during off-peak hours and use a timer as a reminder to turn off the water.

3. **Landscape your yard for low maintenance.** Identify how to use grasses, shrubs, and trees to help the environment. Specific plants are great at preventing soil erosion and soaking up nutrients before they run off into the waters. Have your soil tested to make sure that you plant the right type of grass and shrubbery. Contact your local nursery, extension agent, library, or the Virginia Landscape Architects Association for more information.

4. **Use fertilizers, pesticides, and herbicides as directed, or not at all.** Try to plant plants that don't need chemical maintenance. Use the proper type and amount of fertilizer and ask the "experts" if you have concerns.

5. **Clear drain storms and gutters.** Debris can cause all kinds of problems. Clean leaves, twigs, and other debris and trash from your gutters and storm drains on a regular basis. When you clear it out, put it in the trash or compost pile, and not in the storm drain, where it becomes stream pollution.

Roger Stewart

Everyone depends on clean, clear water to drink, but it's up to all of us to make sure we have an abundant supply.

6. **Maintain your septic system.** If you have a septic system that fails, untreated wastewater could pollute Virginia's ground water and streams. If drains and toilets empty slowly or if effluent seeps to the surface of the ground, your system is not working properly. Learn how to maintain the system and have it pumped and serviced every three to five years to ensure that it functions correctly. Contact your local health department for information about on-site sewage treatment and disposal systems.

7. **Learn proper disposal methods for car care and household cleaning chemicals.** These products can be toxic to fish and wildlife. Learn how to dispose of motor oil, antifreeze, batteries, old tires, other car care products and household cleaners in ways that do not pollute. For information on disposing of hazardous household chemicals, contact your local public works or public service authority. Many have household waste collection programs.

8. **Mark storm drains as a community project.** Whether it is the Chesapeake Bay or one of our rivers or streams that might be impacted, dumping trash into the storm drains is not good stewardship. Visit the Department of Conservation and Recreation's "Adopt a Stream" program web site at http://www.dcr.virginia.gov/stewardship.

9. **Help control shoreline erosion—plant a riparian buffer.** Vegetative buffers help slow the rate of runoff and absorb wave energy, thereby reducing erosion. Plant roots absorb pollutants that might end up in our rivers. These trees, shrubs, and grasses also filter the air and provide food and habitat for wildlife. Along smaller streams, trees provide shade that shelters aquatic life from elevated water temperatures during the summer. For help, call your local Soil and Water Conservation District office or the Virginia Association of Soil and Water Conservation Districts at (804) 559-0324. You can also contact the county Department of Forestry to get seedlings, technical, and financial assistance for planting.

10. **Become a volunteer water quality monitor.** The efforts of citizens help fill in data gaps, provide educational opportunities for their communities and protect valuable natural resources. The Izaak Walton League's Save Our Streams Program and the Alliance for the Chesapeake Bay's Citizen Monitoring Program offer such training. For more information on this Citizens Monitoring program, visit www.deq.virginia.gov/cmonitor.

Citizen Water Quality Monitoring Programs

Virginia's water resources include 49,000 miles of streams and hundreds of acres of lake and estuarine waters. With more than 1,300 monitoring stations throughout the Commonwealth, DEQ boasts one of the largest water quality monitoring networks in the nation. This network is further strengthened by the efforts of environmental organizations that voluntarily collect water quality data on streams, lakes, and estuaries. Their data continues to be an important element in Virginia's efforts toward a complete statewide water assessment.

Two organizations in the forefront of volunteer water quality monitoring in Virginia are the Alliance for the Chesapeake Bay (ACB) and the Izaak Walton League of America (IWLA). ACB volunteers have been monitoring water quality since 1985 and have established stations along several Coastal Plain rivers as well as on the creeks and embayments of the Eastern Shore. Physical and chemical aspects of the water and its surrounding environment are recorded on a weekly basis at the sampling stations. The citizen monitors work from a sampling protocol approved by the EPA and the Virginia DEQ. All volunteers complete an initial training class and two quality control sessions each year.

The IWLA maintains a statewide volunteer water quality monitoring network through its "Save Our Streams" Program. Save Our Streams volunteers are trained in accordance with EPA guidelines to monitor biologic indicators such as benthic macroinvertebrate populations and assess physical stream characteristics. Surveys are made at regular intervals from each of more than 300 sites in 46 counties throughout Virginia. The resulting data are compiled and reported to DEQ and the Department of Conservation and Recreation.

Another form of monitoring, visual monitoring, is becoming more prevalent in citizen monitoring programs. Generally called a "stream walk," this type of monitoring involves documenting things such as tree canopy, stream bank stability, and surrounding land use.

To assure that data collected by citizen monitors is as good as it can be, many groups follow a Quality Assurance Quality Control Program. This plan specifies rigorous checks of the data sampling and analysis methodology and can be quite involved.

The citizen monitoring program at DEQ has developed an effective partnership with other monitoring organizations throughout the state. This has led to the creation of a statewide umbrella organization for citizen monitoring groups called Citizens for Water Quality. This coalition building has been a springboard for the development of new citizen monitoring groups. Virginia is fortunate to have so many citizens who want to make a difference. If you are interested in becoming a citizen monitor, check out the Citizen Monitoring section of the DEQ web page, www.deq.virginia.gov/cmonitor.

WHAT IS WATER?

What is water?
What does it do?
Why is it needed by me and by you?
Water is life, is energy, is fun.
Water is needed by everyone.
It's cool to drink and fun to splash.
It turns a fire into an ash.
So people think they know what water is?
Then why are they wasting it,
Letting it slip away like fizz?
For water is vital, you must realize that.
— Maggie Zellner, Grade 5
James River Day School

DEQ
VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY

There are many programs available for learning about Virginia's environment. Visit www.vanaturally.com for more information, or call the Virginia Office of Environmental Education at 1-800-592-5482.

DEQ
VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY

Stewardship Activity Directory

Choose an activity, make a call, and make a difference!

Activity	Organization	Phone Number
Adopt a Highway	Virginia Department of Transportation	800-PRIDE-VA
Adopt-A-Stream	Department of Conservation & Recreation	804-786-1712
Project Aquatic WILD	Department of Game & Inland Fisheries	804-367-1000
Fish Habitat Enhancement	Berkley Corporation	800-237-5539
"Fish It Out!" Litter Cleanup	Berkley Corporation	800-237-5539
Oyster Gardening	Virginia Marine Resources Commission	757-247-2121
	Chesapeake Bay Foundation	757-622-1964
River of Words	Department of Environmental Quality	804-698-4274
Save Our Streams	VA Chapter Izaak Walton League	540-377-6179
Storm Drain Stenciling	Department of Conservation and Recreation	804-786-9732
Stream Doctor *(Restoration)*	VA Chapter Izaak Walton League	800-BUG-IWLA
Streamside Buffer Planting	Department of Forestry	804-977-6555
Waterway Cleanup	Clean Virginia Waterways	804-395-2602
Wildlife Mapping	Department of Game & Inland Fisheries	804-367-8747
Project WET *(Water Education for Teachers)*	Department of Environmental Quality	804-698-4274
Project WILD	Department of Game & Inland Fisheries	804-367-0188

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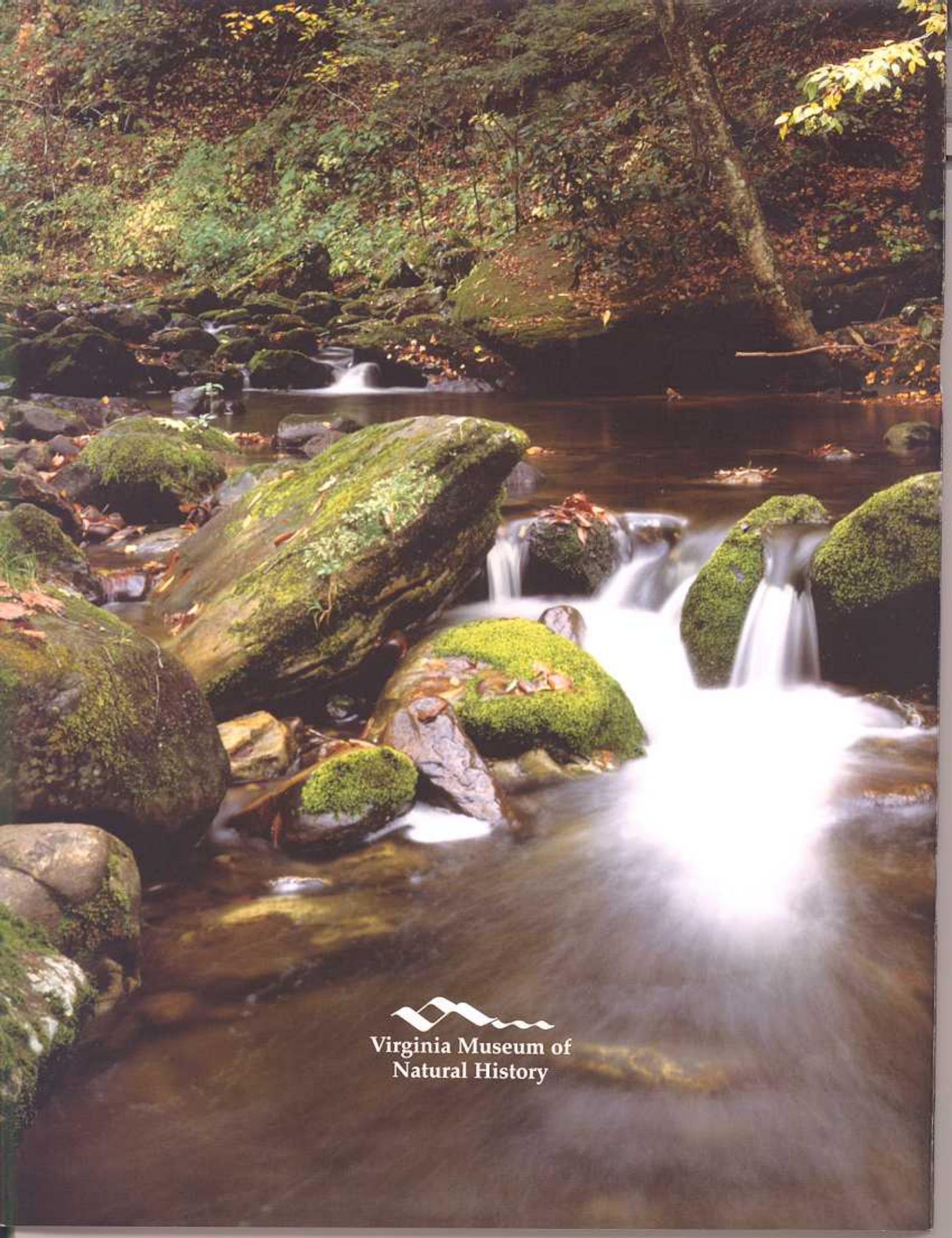
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